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4 ROTARY INTERNAL COMBUSTION ENGINE WITH ADJUSTABLE
5 COMPRESSION STROKE
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14 BACKGROUND OF THE INVENTION

15 This invention relates to a rotatively reciprocating vane internal combustion
16 engine having few moving parts high efficiency, and a low weight-to-power ratio.

17 In an age of environmental concerns and waning natural resources, a lightweight,
18 highly efficient, low fuel consumptive engine has been vigorously sought.

19 In the past, attempts have been made to improve on reciprocating piston engines
20 but their inherent complexity and high weight-to-power ratio has proven limiting. Also
21 rotary or Wankel design engines have become relatively highly developed, they still
22 exhibit daunting problems in rotor sealing and cost parameters. For example, Wankel
23 engine is difficult to manufacture, it has a short life, it has a problem of losing its
24 lubrication and seizing up. It has a poor gas mileage, high oil consumption and high
25 exhaust level. For every three turns of the working piston there is only one rotation of the
26 main power output shaft which results in an excessive friction inside the working
chamber between the piston and the casing.

Some attempts have been made to provide rotary vane engines, which abate some

1 of the aforementioned problems. For example, U.S. Patent No, 4,599,976 to Meuret
2 discloses the utilization of spherically shaped chamber and accordingly shaped vanes,
3 which are used to sequentially compress and expand a combustive mixture. It should be
4 noted, however, that the patented system has the following disadvantages.

5 In Meuret patent the ratio between the volume of the chamber and the diameter of
6 the vanes is constant. If the volume of the sphere chamber changes it automatically and
7 proportionally changes the radius of the vanes. In a cylindrical chamber the volume of the
8 chamber can be changed either by simply changing the length of the cylinder or by
9 changing the radius of the cylinder. In each case there is going to be a different output
10 even though the volume is the same. A cylindrical engine is much easier to manufacture
11 and seal and to open and repair.

12 Another example of a prior art attempt to overcome some of the disadvantages of
13 existing engines is the U.S. Patent No. 4,884,532 to Tan, which teaches an extremely
14 complex swinging piston internal combustion engine. While Tan has made certain
15 admirable advantages, his device suffers from the following disadvantages.

16 The Tan engine is big and bulky. There is no power-to-weight ratio advantage
17 over the conventional engine. It would be difficult to manufacture and repair it. It would
18 be difficult to balance it and it only works as a diesel engine.

19 Unlike the Prior art systems, the present invention provides essentially only one
20 moving element, its rotably reciprocating vane piston. Because of pressure balancing on
21 opposite sides of the vane members, they may be constructed of lightweight material and
22 the need for heavy bearing, and counter-balancing means, are virtually eliminated.
23 The invention is capable of running on multiple types of conventionally available fuel
24 and may conceivably be operated on both, two and four stroke Otto cycle and diesel
25 cycles.

1 SUMMARY AND OBJECTS OF THE INVENTION

2 The instant rotating vane engine comprises a simple rotary vane assemblage
3 mounted within a cylindrical housing having a fixed abutment wall and means for the
4 intake and exhaust of combustible mixture. Primary engine valving is accomplished by
5 simple ports of apertures in the cylindrical housing and the bi-directional rotation of the
6 output shaft, upon which the vanes are mounted, may be made uni-directional by well-
7 known external gearing system.

8 The primary object of the present invention is to provide a rotary internal
9 combustion engine, which quickly, efficiently and economically converts thermal energy
10 into usable kinetic energy.

11 A further object of the present invention is to provide a power plant with
12 essentially one moving element with concomitant savings in materials, weight, labor and
13 all together manufacturing costs.

14 A further object of the present invention is to provide a rotary engine with
15 operating vane wherein the forces on opposite sides of the vanes are essentially balanced
16 and the vibrations are virtually eliminated.

17 Other objects and advantages of the present invention will become apparent from
18 the following drawings and description.

19 The accompanying drawings show, by way of illustration, the preferred
20 embodiments of the present invention and the principles of operation therefor. It should
21 be recognized that other embodiments of the invention, applying the same or equivalent
22 principles, may be utilized and structural changes may be made as desired by those
23 skilled in the art, without departing from the spirit of the invention.

24 BRIEF DESCRIPTION OF THE DRAWINGS

25 Fig. 1 is a cutaway sectional view across the instant rotating vane engine
26

1 incorporating an essential swinging piston output shaft forming 4 chamber rooms inside
2 a cylinder;

3 Fig. 2 shows schematically a cutaway cross section side view of the engine taken
4 along the vertical line passing throw the axis of the swinging piston shaft;

5 Fig. 3 shows a front view of an alternative connecting rod assembly converting
6 the alternating bidirectional rotary motion of the swinging piston output shaft 6 into a
7 continuous unidirectional rotary motion of the main shaft 22 (Fig. 3) The break in the
8 rod at 27 allows for extending and adjusting the length of the rod according to the desired
9 compression inside the working chambers thus regulating the length of the stroke without
10 the need of replacing the rod . The lower end of said rod is rotatably attached to the
11 flywheel via a slot on that flywheel and is affixed to it with a fastening member
12 comprising a bolt and a nut.

13 Fig. 4 shows schematically the relation of the length of the radius R_1 or R_2 formed
14 between the center of the main shaft 22 (Fig.3) and the lower end attachment of the crank
15 pin 20 (Fig.3) to the changing volume of the four chambers a, b, c and d (Fig.1) formed
16 by the swinging piston 6 (Fig.1) inside the main cylinder of the engine, when in
17 operation. A shorter crank pin creates a longer radius and causes the swinging piston 6 to
18 increase its rotational angle allowing for a longer stroke thus instantly creating a higher
19 compression inside the working chambers;

20 Figs. 5 and 6 show the motion of the swinging piston of the engine in operation,
21 forming different volume of the four chambers a, b, c and d inside the cylinder of said
22 engine, according to the invention;

23 Fig. 7 shows schematically a sectional view of the engine with an alternative
24 version of the operative vanes;

25 DETAILED DESCRIPTION

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1 With reference to Fig. 1 in the drawings, the essential concept of the present
2 invention and the means by which it is intended to operate may be appreciated. At 1, a
3 double-walled 13, water-jacketed longitudinally extending cylindrical casing is shown, in
4 section. The casing may be conveniently made of aluminum, steel or other commonly
5 used materials. The casing is equipped at 2 and 3 with longitudinally extending walls,
6 which can be unitary with or affixed to the casing 1. A rotary shaft 6 is suitably rotably
7 mounted within the casing upon end plates 10 and 11. (Fig. 2) for the casing. The shaft is
8 supported in the casing by commonly known bearing means 4 and 5 for mounting a
9 rotary shaft in a motor, pump, or compressor. The shaft is partially hollow to allow the
10 flow of cooling fluids inside it. Similarly to the cylindrical casing the end plates are also
11 double-walled to allow coolant to flow freely from the water pump 25 through all the
12 cavities of the cylinder, the end plates and the shaft in a closed circuit 26.

13 Fixedly attached to or unitary with the shaft 6 are rotating vanes 7 and 8. Suitable
14 seals 9 and 12 are provided between the walls 2 and 3 and the shaft 6 and between the
15 vanes 7 and 8 and the casing 1 respectively.

16 The casing 1 is also equipped with plurality of ports, 14 and 15, which
17 communicate between interior chambers a, b, c and d formed, as shown, between the
18 vanes 7 and 8 and the casing walls 2 and 3. These ports allow the intake of combustible
19 fluids and lubricants and the exhaust thereof from the aforementioned casing chambers.
20 As shown in Figs. 5 and 6 in the drawings, there are four sets of ports, one set for each
21 chamber. Ports 14 are for intake only and ports 15 are for exhaust only. The ports lead
22 conveniently to external valving means the details of which are not a part of this
23 invention. At 24 a compressor, a carburetor or an injection system delivers fuel mixture
24 into the engine. At 23 a box is shown, containing the electrical and electronic system of
25 the engine. The intake ports 14 may be replaced by injection means.

1 Similarly, there are four ignition means, preferably comprising spark plugs,
2 shown schematically at 16, 17, 18 and 19. The precise details of the ignition means, the
3 valving means, the seals are not, in themselves subject of the present invention and
4 various types of known such components could be used provided that the operative
5 characteristics, in combination, are set forth. For example, Wankel type seals could be
6 used.

7 The particular mode of operation of the invention shown in Fig. 1 and 2 now will
8 be described. The vanes 7 and 8 can rotate clockwise and counterclockwise, as shown in
9 Fig. 5 and 6. In so moving the vanes continuously change the volume of the chambers a,
10 b, c, and d.

11 In the position of the vanes shown in Fig 5, vane 7 is moving in counterclockwise
12 direction and air-fuel mixture and lubricant are being drawn in, through the port 14, to
13 the expanding chamber a. At the same time that chamber a is expanding, chamber c is
14 expanding due to ignition of previously compressed fuel mixture as the vane 8 rotates
15 counterclockwise towards the wall 2.

16 Simultaneous with the expansion of the chambers a and c, are the contractions in
17 chambers b and d. The fluid in chamber b is being compressed by the vane 8 against the
18 wall 2 at the same time as exhaust fluid in chamber d is being purged from that chamber
19 through the aforementioned chamber port 15. At maximum compression in chamber b,
20 ignition means 17 fires and causes vane 8 to rotate now clockwise with concomitant
21 expansion of chamber b and d. At the same time exhaust gases in chamber c are being
22 purged from that chamber through its port 15 and the combustible fluid mixture in
23 chamber a is being compressed preparatory to ignition of spark igniter 16 at the point of
24 maximum compression. A new fuel mixture is being drawn in in chamber d through its
25 port 14 as it is expanding and the vane 7 is moving towards the wall 2.

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1 At maximum compression, the igniters fire sequentially, in the known manner, so
2 that each chamber a, b, c and d experiences first an intake cycle then a compression
3 cycle, then an ignition-expanding cycle, and finally, an exhaust cycle.

4 In a two stroke, four chamber operation the engine works as follows. When the
5 vanes 7 and 8 move in counterclockwise direction fuel mixture and lubricant are being
6 drawn in the expanding chambers a and c through intake ports 14, (Fig.1), after the vanes
7 move past these ports. At maximum compression in chambers b and d spark plugs 17 and
8 19 ignite the compressed gases and cause the vanes 7 and 8 to move now in clockwise
9 direction, compressing the previously drawn fuel mixture in chambers a and c. At the
10 same time the burned gases in chambers b and d are free to leave through exhaust ports
11 15 after the vanes move past these ports and new fuel mixture and lubricant enter
12 these chambers through intake ports 14. At maximum compression in chambers a and c
13 the spark plugs 16 and 18 ignite the combustible mixture and cause the vanes to move
14 again in counterclockwise direction, the rest of the previously burned gases are being
15 purged from chambers b and d and at the same time new fuel mixture and lubricant enter
16 the chambers a and c through the ports 14. The four chamber, two stroke operation of the
17 engine may be replaced by only a double or even a single chamber operation where all of
18 the processes described above are essentially the same.

19 In the alternative embodiment of Fig. 7, the rigid longitudinal vanes 7 and 8 are
20 replaced by articulating vanes 28, 29, 30 and 31. In operation, with respect to the vane
21 segments 29 and 30 the operation is as previously described with respect to Figs. 1, 5 and
22 6. However, because of the articulated vane sections 28 and 31, the shaping of the
23 chambers a, b, c and d is different from that shown in Fig. 1, 5 and 6. The articulated
24 vane segments 28 and 31 are suitably mounted for slidable rotation within slide-bearing
25 means 32 and 33. The bearings are rotatable within the casing while allowing vane
26

1 segments 28 and 31 to slide therethrough.

2 As shown in Fig. 7, chambers are formed between the walls 2 and 3 and the vanes
3 28-29 and 30-31. As the vane segments 29 and 30 rotate clockwise, the vane segments 28
4 and 31 respectively nutate about the joints 34 and 35 while simultaneously sliding within
5 the bearings 32 and 33. The chambers a, b, c and d, therefore, expand and contract in a
6 balanced fashion similar to the straight chambers shown in the embodiment of Figs. 1, 5
7 and 6.

8 Thus the preferred embodiments of the invention have been illustrated and
9 described. It must be clearly understood that the preferred embodiments are capable of
10 variation and modification and are not limited to the precise details set forth. For
11 instance, it is apparent that the parts may be modified in size and materials without
12 effecting the essence of the invention. This invention includes all variations and
13 modifications, which fall within the scope of appended claims.

14 What is claimed is:

15 1. A rotatably reciprocating vane internal-combustion engine comprising a water
16 jacketed, double-walled (optional) cylindrical casing (1) allowing for cooling fluids to
17 pass through it; said casing equipped with longitudinally extending walls (2 & 3) unitary
18 or affixed to the casing; vanes (7 & 8) unitary or affixed to shaft (6), said shaft rotatably
19 alternating in a back and forth fashion and together with the vanes referred to as the
20 swinging piston; said power output rotary shaft (6) is mounted within the casing upon
21 double-walled (optional) end plates (10 & 11); sealing strips (9 & 12, optional) embodied
22 in grooves and provided between the walls (2 & 3) and the shaft (6), between the vanes
23 (7 & 8), the casing (1) and the end plates (10 & 11) respectively; four working chambers
24 (a, b, c and d) formed between the vanes (7 & 8) and the walls (2 & 3) inside the casing
25 change their volume in accordance with the alternating position of the vanes, each of the
26 four chamber rooms experiencing an intake, a compression, an ignition-expanding and